

# Development of Nanopore Sequencing for Automated Ocean World Life Detection

Completed Technology Project (2017 - 2019)



## Project Introduction

In this COLDTech project, a solid-state nanopore instrument will be developed for the detection and study of biomarkers for microbial life in ocean world environments. The Sequencing of Life on Ocean Worlds (SeqLOW) instrument is a solid-state nanopore platform designed for the detection and characterization of polyanionic and polycationic polymers. SeqLOW heritage is derived from Oxford Nanopore's MinION instrument, a commercial off the shelf (COTS) product. The MinION is a small, portable DNA sequencing platform that consists of protein nanopores embedded in an electrically resistant polymer material. The MinION is third generation sequencing technology and is robust enough for in situ field analysis here on Earth. The system is slated to be tested on the International Space Station in the summer of 2016. However, the integrity of the current protein nanopore membrane used in the MinION is not sufficiently robust to survive long duration space missions. The SeqLOW solid-state nanopore platform will advance current state-of-the-art nanopore sensing technology as a life detection instrument for use in future NASA missions. SeqLOW COLDTech development goals are: 1) Development and fabrication of robust solid-state nanopore membranes with arrays of different pore diameters for detection of multiple types of biomarkers (i.e. DNA, charged proteins, amino acids, etc.). 2) Integration of the SeqLOW membranes into a microfluidic platform for in situ life detection. Microfluidics will be used to carry out sample processing, concentration, and delivery of the sample material to the solid-state membrane for analysis. Technologies and methods will be developed for sensor operation during deep space missions that eliminate: a) loss of analyte integrity, b) disruption of nanopore aperture, or c) disruption of pore current by sample interferences. SeqLOW directly addresses the goals of the COLDTech program and NASA by "development of spacecraft-based instruments and technology for surface and subsurface exploration of ocean worlds such as Europa, Enceladus, and Titan." SeqLOW also will address the NASA Planetary Science Division's strategic goals and objectives and is focused on the detection of extant life in the "Ocean Worlds" of the outer Solar System.

## Anticipated Benefits

The results from development and testing of this instrument will demonstrate its viability as a life detectionsystem capable of being incorporated onto either a lander or orbiter for future missions.



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## Organizational Responsibility

### Responsible Mission Directorate:

Science Mission Directorate (SMD)

### Responsible Program:

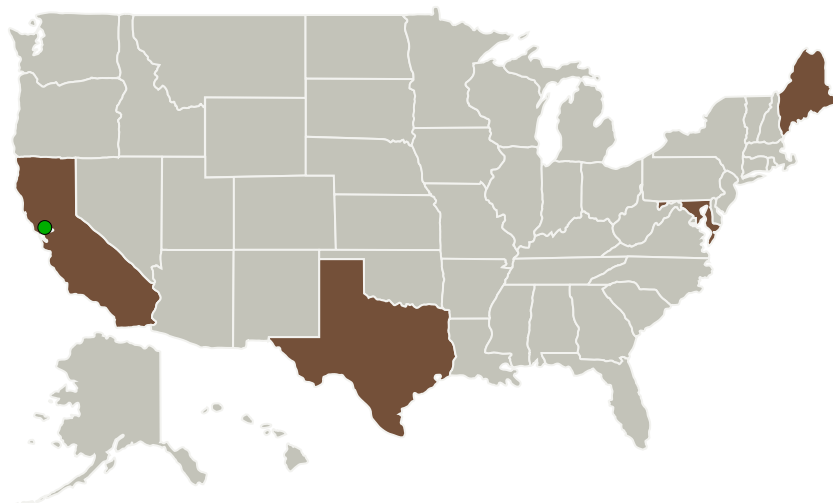
Concepts for Ocean Worlds Life Detection Technology

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## Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
● Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California

Primary U.S. Work Locations	
California	Maine
Maryland	Texas

## Project Management

### Program Director:

Carolyn R Mercer

### Program Manager:

Carolyn R Mercer

### Principal Investigator:

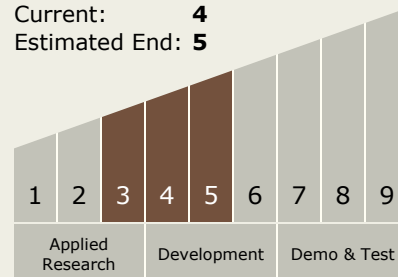
Christopher P Mckay

### Co-Investigators:

Aaron Burton  
Alfonso F Davila  
James A Clarke  
Lyle G Whyte  
Holger Schmidt  
Jason P Dworkin  
David Deamer  
Joseph A Russell  
Jacqueline Goordial  
Jonathan L Jacobs  
Sandra Owen  
Wenonah A Vercoutere  
Kathryn F Bywaters  
Richard C Quinn  
William B Brinckerhoff

## Technology Maturity (TRL)

Start: 3  
Current: 4  
Estimated End: 5



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## Technology Areas

### Primary:

- TX08 Sensors and Instruments
  - └ TX08.3 In-Situ Instruments and Sensors
    - └ TX08.3.4 Environment Sensors

## Target Destination

Others Inside the Solar System